Subject title: Tracing the Archean Earth in modern ocean basalts from multiple sulfur isotopes signatures

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Host lab/ Team: ***IPGP – CAGE and Stable Isotopes teams***

Financing: ***Doctoral contract on the SHRED ERC project without teaching assignment***

Summary : We are looking for a PhD student to join an international team to study the Early Earth geodynamics. The planned Ph.D. project will largely be based on multiple sulfur isotope geochemistry (i.e. mass-independent isotope signatures) of sulfide and melt inclusions from mantle-derived lavas and glasses (mostly ocean island basalts) as a witness of Archean recycled sedimentary material in the mantle. Techniques will primarily rely on both gas-source and laser-ablation multi-collector ICPMS. Experience with high-temperature geochemistry (particularly isotope geochemistry) is preferred, but not required.

Presentation of the subject:

The Earth's atmosphere was free of O_2 until ca. 2.4 Gy. Without any ozone-induced UV-shielding, photochemical effects led to unique sulfur isotope signatures that are preserved in the sedimentary record, characterized by non-zero $\Delta^{33}S$ and $\Delta^{36}S$-signatures in the Archean and near-zero $\Delta^{33}S$ and $\Delta^{36}S$-signatures since the Proterozoic (Figure 1, Farquhar et al., 2000). Their recycling into the Earth's mantle (which has zero $\Delta^{33}S$ and $\Delta^{36}S$-signatures) provides a powerful witness of exchanges of old material between the surface and deeper reservoirs of our planet.

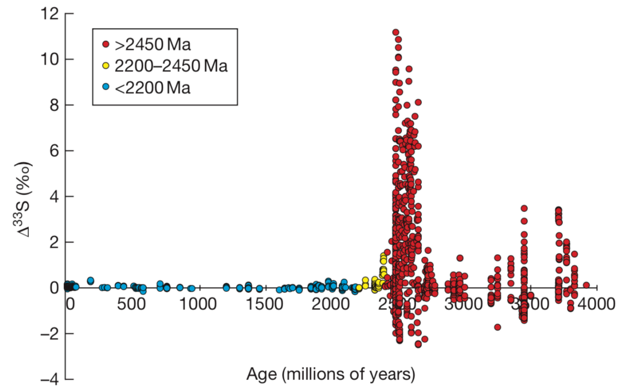

Figure 1 : the sulfur sedimentary record showing the occurrence of non-zero (mass-independent) $\Delta^{33}S$ signatures

The mantle $\Delta^{33}S$ record remains very scarce. Diamonds from the continental lithosphere (150-250 km) provided a first record of non-zero $\Delta^{33}S$ (e.g. Cartigny et al., 2009) but this type of sample cannot be easily linked to other geochemical tracers (e.g. Sr, Nd etc..).

Ocean island basalts despite their unique ability to sample deep and old recycled components, as established from Nd, Hf, Pb and W-isotopes, remain little studied, mostly because they are both degassed and that glasses are rare. Lavas are more common but degassed and crystallised/*expressed* sulfides are prone to alteration. Importantly, the few available data are ambiguous (Cabral et al., 2013; Delavault et al., 2016; unpub. data) showing both absence and occurrence of mass-independent signatures of S-isotopes within a same series of samples.

To clarify this important issue, the goal of this PhD project is to provide an extensive dataset of multiple S-isotopes. The present work will concentrate on basalts from the Polynesian islands with a strong focus on those having the most extreme radiogenic isotopic compositions, i.e. which record the most pristine recycled components (Chauvel et al., 1992). The PhD candidate will use multiple techniques including (1) fluorination-vacuum techniques coupled to gas-source mass-spectrometry and will contribute to the analysis of single sulfide grains, bulk rocks and sulfide standard calibration for MC-ICPMS (2) laser-ablation multi-collector ICPMS. The second technique will be developed by the PhD student and will allow the first analyses of S-isotopes from melt inclusions.

The PhD project will be part of a larger project aiming at finding traces of early Earth materials in the source of plume volcanism. This project is funded by the SHRED ERC project led by Catherine Chauvel.

Références :

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